

## FINAL OVERVIEW:

### ORGANIZATION OF BODY:

- a. Negative feedback: reverses the change in controlled condition.
- b. Positive feedback: tends to strengthen or reinforce a change in one of the body's- controlled condition.
- c. Anterior- in front same as ventral, posterior- back same as dorsal.
- d. Proximal near the trunk, distal away from the trunk.
- e. Sagittal plane- left and right parts, midsagittal – equal left and right, parasagittal – unequal left and right.
- f. Frontal plane divides body into anterior and posterior.
- g. Transverse- superior and inferior.

### TISSUES: (EpCoMuNe)

- a. Epithelial- (avascular) lining GI tract and hollow organs, epidermis of skin. Types- covering and lining epithelium, and glandular epithelium, they have cilia and microvilli, highly cellular, the epithelial cells are connected by adhesive cell junctions.
- b. Epithelial cells: squamous(flat), cuboidal- they have microvilli function is either absorption or secretion, columnar- same as cuboidal, transitional- change shape (found in urethra and urinary bladder).
- c. Simple squamous epithelium- single layer, gas exchange and lining of blood vessels. **ENDOTHELIUM**- type of simple squamous epithelium that lines the heart, blood vessel and lymphatic vessels.
- d. Simple cuboidal epithelium- PCT and DCT, covers surface of ovaries, absorption, and secretion.
- e. Simple columnar epithelium- types- **non ciliated**: contain microvilli (increase surface area) and goblet cells (secrete mucus, it can cause acute bronchitis) present in respiratory tract, digestive and reproductive tract. **Ciliated columnar epithelium**- have cilia and apical surface- found in fallopian tubes and cilia helps to move oocytes. Pseudostratified columnar epithelium- cells are attached at base but nuclei at different levels.
- f. Stratified squamous epithelium- types: keratinized SSE- develop tough layer of keratin at apical surface (forms superficial layer of skin), non- keratinized- do not have keratin, wet surfaces- lining of mouth. Stratified columnar and cuboidal are used for absorption and secretion as well.
- g. Glandular epithelium- types: endocrine glands- produce hormones, exocrine glands- sweat glands oil glands earwax.

### CONNECTIVE TISSUE:

- a. Cells: plasma cells- immune response, adipocytes-fat cells, macrophages- WBCs, phagocytes, mast cells – kill bacteria.

- b. Matrix: ground substance is the components of connective tissue found b/w cells and fibers.
- c. Fiber types: collagen- very strong, elastic fibers- smaller than collagen, protein found is ELASTIN surrounded by FIBRILIN can be stretched, Reticular fibers- provide support in walls of blood vessels provides supporting framework for organs such as spleen and lymph nodes.
- d. Connective tissue types: loose and dense: loose CT- loosely packed, areolar (most widely spread, areolar+ adipose= subcutaneous layer of skin), adipose( storage of fats, as the amount of adipose tissue increases blood vessels form , and obese person has more blood vessels which leads to high bp, and reticular ( forms stroma of liver, spleen, lymph nodes, red bone marrow and gives rise to blood cells, dense CT- dense regular ( bones)- collagen fibers regularly arranged in bundles, fibroblasts present between bundles, these form tendon ligament- strong attachment and dense irregular- randomly arranged collagen fibers (present in deeper region of dermis) and elastic connective tissue- mainly found in lung region as lungs contract and relax .
- e. Blood and lymph are liquid connective tissue.

CARTILAGE: avascular, heals poorly

- a. Dense network of collagen and elastin fibers embedded in CHONDROITIN SULFATE rubbery substance in ground substance. The cells of the mature cartilage are called CHONDROCYTES occurs within spaces called LACUNAE.
- b. Hyaline cartilage- most abundant type of cartilage found in ends of long bones, anterior ends of ribs, nose, weakest type of cartilage.
- c. Fibrocartilage (strongest type of cartilage) - consists of chondrocytes mature cartilage cells, lacks perichondrium (dense layer of fibrous connective tissue)
- d. Elastic cartilage- perichondrium present, chondrocytes present, maintain shapes, found in eustachian tubes.

MEMBRANES: cover parts of body

Types- connective tissue membrane which includes synovial membrane- joints; epithelial membranes-includes mucous membranes- lines body cavities that open directly to the exterior(found in digestive, respiratory, urinary and reproductive tracts) , serous membranes- lines body cavities that does not open directly into exterior( found in peritoneal pleural and pericardial cavity) , and cutaneous membranes- covers skin

### **skeletal system:**

facial and bones of vertebrae are irregular bones, flat bones are cranial, sternum, ribs and shoulder blades. the bone grows in length from the epiphyseal plate which has cartilage once the bone stops growing this

cartilage is replaced by a bony structure called the epiphyseal line. periosteum - around the bone made of dense irregular connective tissue and has blood vessels, medullary cavity contains yellow bone marrow and MC is covered by endosteum. tissue hardening- calcification initiated by osteoblasts.

osteogenic/progenitor are stem cells. compact bone has osteons which has osteonic channel for blood supply, they have rings of concentric lamella within the lamella osteocytes live, spongy bone no osteons and are arranged in trabeculae and cavities are filled with RBM. intramembranous ossification- bone forms directly from mesenchyme, endochondrial- where bone forms within hyaline cartilage that develops from mesenchyme, primary OC- as the blood vessels stimulate cells to become osteoblasts and secondary OC- when blood vessels reach epiphysis. intramembranous for flat bones and endochondrial for long bones. bone resorption- osteoclasts, and deposition- osteoblasts.

biologically active form of vit.d2- calcitriol and primary form of circulating vit.d is calcidiol. higher PTH stimulates osteoclasts to break down bone matrix and lower PTH slows osteoclast activity. calcitonin released by thyroid glands stimulates the activity of osteoblasts. sternum is divided into- manubrium, body and xiphoid process. false pelvis is greater than true pelvis. bones of pelvic girdle- ilium, pubis and ischium, ilium is more flared in women and they also have increased Q-angle.

### **muscular system:**

endomysium- individual muscle fibres; perimysium- fascicles and epi- entire muscle. skeletal muscles have blood supply and they are multinucleated and smooth and cardiac muscles are uninucleated. triad is T-tubule+terminal s=cisterna. each myosin has 6 polypeptide chains, 2 heavy and 4 light. tropomyosin is wrapped around actin and covers the active sites for binding and prevents the formation of actin-myosin bridge. troponin is protein attached to tropomyosin that initiates the process of contraction. calcium ions release from sarcoplasmic reticulum and binds to troponin to displace the tropomyosin as a result binding sites are now opened. motor unit- a single muscle neuron along with muscle fibres. in the NMJ axon terminals have several voltage gated calcium channels, during depolarization. voltage gated calcium channels open the inflowing Ca forms a complex Ca-calmodulin complex which phosphorylates the synapsin protein, after phosphorylation it releases synaptic vesicles. these vesicles fuse with neural membrane at the endplate releasing Ach in synaptic cleft. generation of muscle action potential,  $\text{Na}^+$  inflows down its concentration gradient. ATP,  $\text{Ca}^{2+}$  and energy are needed for muscle contraction. skeletal muscle fibres have 3 sources of ATP; creatine

phosphate where ADP forms ATP, anaerobic glycolysis, aerobic respiration. the inability of muscle to contract forcefully after prolonged activity is muscle fatigue; Recovery Oxygen Uptake- elevated oxygen use after exercise. cardiac muscle- uninucleate, intercalated discs depends on aerobic respiration for ATP, discs have gap junctions- flow of ions, adhering junctions- connects ends of myocytes to form fibre, desmosomes- prevent separation.

**depolarization of sarcoplasm is lasts longer in cardiac muscle.**

smooth muscles- intermediate filament and dense body( which is analogous to Z-discs in skeletal muscles), these muscles are also uninucleate and like sarcomeres, the specialized cells are called fibroblasts which produce connective tissue proteins- collagen and elastin

**the skeletal muscles contract faster than smooth muscles. smooth muscle tone - is a state of continuous partial contraction of smooth muscle tissue.**

actin and myosin are constantly binding., axon swelling- varicosities or boutons, smooth muscles lack myofibrils and they are resistant to fatigue. fixator- stabilizes the origin of the prime mover so that it can move more efficiently. supinator- turn palms anterior and pronator - turn palms posterior, tensor- make body rigid

### **respiratory system:**

conducting zone- series of interconnecting cavities and tubes, respiratory zone- consists of tissues within the lungs where gas exchange occurs. Nose- cartilage and skin, regions of nose- vestibular, olfactory and respiratory.

Pharynx- throat (passage way for air and food), houses of tonsils (palatine, lingual and pharyngeal), 3 types of pharynx - nasopharynx only for respiration and house for palatine tonsils, oropharynx and laryngopharynx for both digestion and respiration. larynx- voice box and epiglottis covers the larynx, it contains - thyroid cartilage(adam's apple), cricoid cartilage, epiglottis, arytenoid cartilages and false and true vocal cords.

trachea(wind pipe) lined with pseudostratified ciliated columnar epithelium. at T4-T5 the trachea bifurcates, into bronchi the right and left mainstem, and the site of bifurcation is the carina.

Lungs- enclosed by pleural membrane, parietal pleura is outer layer and visceral is inner. right lung- 3 lobes (horizontal and oblique fissure) and left lung has 2 lobes (oblique fissure and cardiac notch)

Branching tree (conducting zone)- trachea- main/primary bronchi- lobar/secondary bronchi-segmental/tertiary bronchi - bronchioles -terminal bronchioles.

Respiratory zone- respiratory bronchioles- alveolar ducts- alveolar sacs- alveoli. cells of alveoli- type 1 - gaseous exchange and type 2 - caretaker and progenitor cells and type 2 cells also synthesise pulmonary surfactant. muscles for FORCED INHALATION- diaphragm contracts (goes down) , SCM, scalens and pectoralis minors. RELAXED INHALATION - external intercostal muscles participate. FORCED EXHALATION- internal intercostals , external and internal oblique , transvers and rectus abdominis. volume - amount of air for one function either inhale or exhale, capacity- two or more volumes. lung capacities are combinations of specific lung volumes. partial pressure- the pressure of specific gas in mixture.

**External respiration (pulmonary gas exchange)- between alveolar air and pulmonary blood capillaries.**

**internal respiration (systemic gas exchange)- between systemic tissue capillaries and systemic tissue cells.**

About 98.5% blood O<sub>2</sub> is bound to haemoglobin in RBCs. CO<sub>2</sub> is transported in 3 ways- 7% dissolved in plasma, 23% combines with globin in haemoglobin and 70% converted as bicarbonate ions . low pH high respiratory rate.

Respiratory centre- medulla oblongata and pontine respiratory group in pons. Abrupt increase in ventilation is due to neural changes and gradual increase is due to chemical and physical changes. With aging lung capacity decreases and alveoli become less elastic and rigid.

### **Lymphatic system:**

Lymphatic tissue- reticular connective tissue. Functions of LS- drains excess interstitial fluid, transports lipids, immune response. Lymph nodes have B and T cells surrounded by capsule. Flow of lymph aids return of venous blood to the heart. 2 pumps – respiratory pump- during inhalation flow of lymph increases as the thoracic cavity pressure decreases, skeletal muscles pump- when muscles contract the valves are forced open and lymph flows faster. RBM- only in flat and long bones. Thymus – 2 lobes separated by septae. Thymocytes develop into lymphocytes via + and – ve selection. Lymph nodes heavily concentrated near mammary glands, axilla and groin , B cells develop into plasma cells . lymphatic nodules are found in GI tract, urinary reproductive and respiratory tracts. Spleen- largest single mass on left side of the body between stomach and diaphragm covered by capsule of dense connective tissue, has white pulp- immune response and red pulp- worn out blood cells and platelets are removed.

Immunity: innate from birth and adaptive which involves lymphocytes ; first line of defence- skin mucous membrane , second line of defence- antimicrobial substance (ICIA), phagocytes, NK cells inflammation and fever. When antimicrobial substance is passed the next non specific defence is phagocytes and NK cells. Fever intensifies effects of interferons

Adaptive immunity- involves B and T cells, 2 types of adaptive immunity- cell- mediated and antibody mediated

Immunoglobins – IgG most common , memory cells remember the first attack. Memory helper T, memory B and memory Cytotoxic T .

T- cells : memory t cells( rapid increase in the number of t cells when re-exposed to specific antigen); helper t-cells assists other wbc in reponse; cytotoxic t-cells- destroys tumous cells

IgG – from mother to fetus from placenta and IgA breast feeding (naturally acquired passive immunity from mother)

### **Nervous system:**

Dendrites- receiving impulse, axons – to another neurons and cell body for integration.

Astrocytes- protect neurons and blood- brain barrier, microglial- invading microbes, ependymal cells – lines the ventricle and make CSF, oligodendrocytes- myelin sheath, shwaan cells – myelin sheath, satellite cells – support neurons and regulate exchange of materials. White matter- myelinated axons and gray matter rest all things.

In resting potential- one that is not transmitting impulses has slightly -ve charge inside which is -70mV . in resting potential sodium is moved out and potassium is moved it is against the concentration gradient.

Depolarization- opening of sodium channels, then the sodium moves in the membrane because there is greater concentration of sodium ions outside which were accumulated in the resting potential. And this is followed by opening of voltage gates – K<sup>+</sup> channels allows repolarization.

Myelinated axons conduct impulse faster, and the one with larger diameter also conducts impulses faster.

### **BRAIN:**

Arachnoid matter- connective tissue, avascular.

Sub- arachnoid – CSF, cushion of the brain.

First and second ventricles communicate with third ventricles through foramen of munro and third ventricle connects with fourth through aqueduct of sylvius. Thalamus and hypothalamus are in 3<sup>rd</sup> ventricle of brain. CSF protects the brain and spinal cord from physical injury and remove wastes.

Frontal lobe: movement, broca's area

Parietal lobe: language

Temporal lobe- visual memory and language (sensory)

Occipital lobe- visual

Thalamus- major relay station. Limbic system – amygdala- emotional almond shape, hippocampus- memory processing shape seahorse. Corpus collasum – connecting two

hemispheres. Cerebellum – two hemispheres , medulla is cardiovascular and respiratory centre.

**SPINAL CORD:**

ANS has two parts parasympathetic (rest and digest) and sympathetic( stress/fight or flight) 31 spinal nerves and 12 cranial nerves. Nerve is wrapped by epineurium, group of axons/bundles/fascicles is covered by perineurium and individual axon is by endoneurium. Cranial nerves- 3,6,12,4,11 motor and 1,2,8 sensory rest all are both.

**ANS regulated by hypothalamus and brain stem.**

**Organs that receive impulse from both parasympathetic and sympathetic neurons – dual innervation.**

**Sympathetic division- thoracolumbar division, parasympathetic division – craniosacral division.**

**In parasympathetic division- postganglionic axons are very short , and preganglionic axons are the longest than the sympathetic division.**

**Ach is released by:**

- a. All preganglion both para and sym**
- b. All Para post**
- c. Some sym post**

**And some sym post release nor-epinephrine.**

**Cardiovascular system:**

Blood pH 7.4 and 5-6 litres. 55% of blood is plasma which has 90% of water, platelets play a role in coagulation, WBCs lives for 13-20 days.

Lymphocytes( agranulocytes)- B cells develop into plasma cells and produce antibodies, T cells- attach viruses, fungi and cancer cells , and NK cells – attack microbes and tumour cells. Monocytes are largest WBCs and are phagocytic cells (macrophages)

**GRANULOCYTES:**

Neutrophils-most abundant , acute bacterial infection

Eosinophils- allergic reactions.

Basophils- inflammatory agents.

Pluripotent stem cells; myeloid stem cells – RBCs, platelets, B cells, monocytes

Lymphoid stem cells – T lymphocytes , B lymphocytes and NK cells

Hemostasis- responses that stops bleeding when blood vessels are injured, 3 mechanisms are:

- a. Vascular spasms
- b. Platelet plug formation
- c. Blood clotting (prothrombin to thrombin with the help of prothrombinase and then thrombin helps convert soluble fibrinogen to insoluble fibrin)

Clotting in an unbroken vessel is called thrombosis. A thrombus that moves from its site of origin is embolus. Anticoagulants- heparin

Blood vessels :

Arteries- 3 layers- endothelium, smooth muscle and outer layer, elasticity and contractility  
Arterioles, smaller arteries that deliver. Flow Blood from arteries to capillaries, they constrict and dilate.

BP rise when ventricles contract which is systolic pressure and BP drops when ventricles relax diastolic pressure.

The CV centre receives impulse from 3 main types of sensory receptors- baroreceptors(bp), proprioceptors( physical ) and chemoreceptors(chemical)

The membrane that protects heart is pericardium layers of pericardium: Fart Police Smell Villains.

F – fibrous pericardium

P- parietal layer

S- serous fluid

V- visceral fluid.

Heart wall consists of :

Epicardium – outermost layer, myocardium – middle layer, endocardium- simple squamous epithelium

The heart hole is called fossa ovalis which before birth is called foramen ovale.

Conduction system: SA node- AV node – AV bundle (bundle of HIS) – bundle branches- purkinje fibres . AV bundle(bundle of HIS) is the only site where action potential can conduct from atria to ventricles)

lubb- longer when AV valves close, dubb- shorter, semilunar valves closing.

p- atrium systole, QRS- ventricle systole , T- ventricle diastole .

## **REPRODUCTIVE SYSTEM:**

Testis- tunica albuginea

Seminiferous- rete testis- efferent ductulus- epididymis.

Seminiferous tubules- sperm production

Epididymis- sperm maturation



Vas deferens- transport sperm and joins seminal vesicle duct to form ejaculatory duct

Prostate gland- do nut shaped, 25% of seminal fluid,

Seminal vesicles- 60% of volume of semen.

Bulbourethral glands – secrete mucus for lubrication.

Semen is mixture of sperm and seminal fluid. Scrotum has dartos muscle.

Paired erectile tissue- corpora cavernosa , erectile tissue- corpus spongiosum.

**Spermatogonium 2n- primary spermatocyte 2n – secondary spermatocyte n – spermatid n- sperm**

Spermatid is immature

LH releases testosterone by Leydig cells/ interstitial cells and Sertoli cells release inhibin which stops the FSH activity.

Female reproductive system:

Vagina – stratified squamous epithelium. Uterus parts- fundus, body and cervix

Uterine walls – perimetrium external, myometrium – middle and endometrium innermost has 2. Parts- deep stratum basalis – which does not shed and superficial stratum functionalis - which sheds.

Oogenesis:

Meiosis 2 is only completed after sperm fuses with ovum.

Uterine cycle- menstruation and ovarian cycle – egg

FSH secrete estrogen and LH- secrete progesterone and estrogen both, formation of corpus luteum .

Female reproductive cycle:

Preovulatory phase- group of follicles start maturing and one of it over matures and others die, estrogen are dominant hormone in pre.

Ovulation is rupture of graafian follicle and release of secondary oocyte. Ovulation is brought about by LH surge .

postovulatory- both pro and estrogen are secreted in large amount , if fertilisation does not occurs corpus luteum degenerates resulting in low level of progesterone and oestrogen allow discharge of endometrium , if fertilization occurs the corpus luteum is maintained by hCG- human chorionic gonadotropin hormone .

Relaxin – increases the pubic flexibility synthesized by corpus luteum.

After one meiotic series one egg is produced.